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PENSOFT

First record of the family Parodontidae (Characiformes) from the Paraíba do Sul river basin, southeastern Brazil

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Abstract
The first records of 2 species of Parodontidae (*Apareiodon piracicabae* and *A. itapicuruensis*) are reported in the Paraíba do Sul river basin. In total, 101 individuals of *A. piracicabae* and 3 individuals of *A. itapicuruensis* were collected in the Paraíba do Sul middle reaches. A description and diagnosis of both species based on morpho-meristic characters were provided. These fishes have been used as forage for larger fish species as well as bait for sport fishing, which may have facilitated their introduction in the Paraíba do Sul River from fish culture farms in the region.

Key words
Apareiodon; geographic distribution; occurrence; Paraíba do Sul River.

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Introduction

The Parodontidae family belongs to the Characiformes order and is comprised of 3 genera (*Apareiodon* Eigenmann, 1916, *Parodon* Valenciennes in Cuvier & Valenciennes, 1850, and *Saccodon* Kner, 1863) and 31 species (Eschmeyer and Fong 2017). This family is distributed throughout the South Americas and part of Panama, but absent in some South America coastal basins, in Patagonia, and in the Amazonian channel (Pavanelli 2003). Most of the species of this family, known as darter characins or scrapetooths, do not reach 150 mm in total length, do have fusiform bodies, and have the head without fontanel (Pavanelli 2003).

The genus *Apareiodon* has 18 valid species is defined by a spatulate and edentulous lower jaw (Pavanelli 2003, Pavanelli and Britski 2003). They are small individuals of low economic value and have already been used as forage for larger fish species and as bait for sport fishing (Bialetzki et al. 1998). Species of this genus shows trophic and habitat plasticity and are found dwelling in streams, rivers, and reservoirs (Bialetzki et al. 1998). This genus has been recorded in the Paraná, São Francisco, and Tocantins river basins and in small coastal rivers from northeast Brazil (Sazima 1980, Bialetzki et al. 1998, Pavanelli and Britski 2003).

In this study, we present the first records of *Apareiodon itapicuruensis* Eigenmann & Henn, 1916 and

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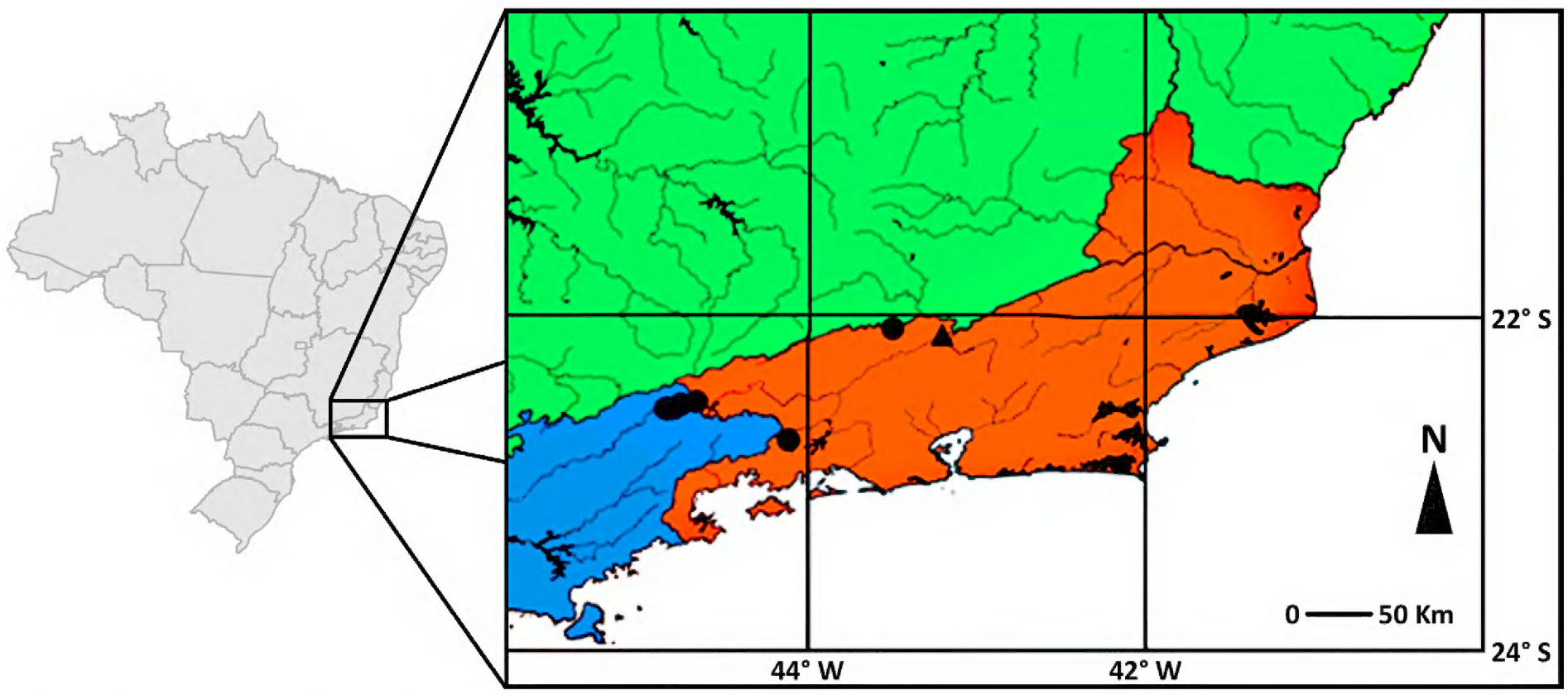

Figure 1. Map of the study area with new geographical distribution of *Apareiodon itapicuruensis* (triangle) and *Apareiodon piracicabae* (circles) in the Paraíba do Sul river basin.

Apareiodon piracicabae (Eigenmann, 1907) in the Paraíba do Sul River (22°04′–22°56′S, 044°40′–44°48′ W, datum WGS84). Although the ichthyofauna of the basinhas been well studied (e.g. Bizerril 1999, Teixeira et al. 2005, Araújo et al. 2009) there are yet no data on the presence of darter characins or scrapetooths from the Parodontidae family.

Methods

Specimens of *Apareiodon* were collected in different sites of the Paraíba do Sul River middle reaches (Fig. 1) during 2 periods: from February 2008 to May 2009 (7 excursions) and from October 2012 to July 2013 (4 excursions). Fish were sampled with different gear following the river channel structure. We used gill nets (15–50 mm), mesh trays (diameter of 80 cm and 1 mm mesh), and electrofishing (AC 900W, 220 V, 1–2 A power generator). In total, 156 specimens were collected (101 individuals of *A. piracicabae* and 3 individuals of *A. itapicuruensis* were examined) (Table 1). All fish were fixed in 10% formalin and, after 48 hours, preserved in 70% ethanol. Vouchers specimens were deposited in the Ichythyological Collection of the Laboratory of Fish Ecology, Universidade Federal Rural do Rio de Janeiro (LEP-UFRRJ 1455 = *A. itapicuruensis*; and LEP-UFRRJ 0984–0986, 1028, 1081–1082, 1211–1213, 1453–1454, 1456, 1467, 1546, 1548, 1565, 1611-1612, 1631–1635, 1645, 1650 = *A. piracicabae*; Figs 2, 3).

Diagnostic characteristics for species identification were: (1) body height, (2) number of scales in the lateral line, (3) number of scales in the series between the isthmus and anus, (4) numbers of crossbars,and (5) number of dental cusps. These characters are commonly used in taxonomy and phylogeny of the genus *Apareiodon* by Pavanelli (2006). We also included an additional measure, following Pavanelli and Britski (2003): the distance between the isthmus origin and pectoral-fin origin.

Results

New records. *Apareidon itapicuruensis*: Brazil, Rio de Janeiro, Paraíba do Sul River, Três Rios (22°07′16″ S, 043°12′34″ W), B.C.T.Pinto, 07/ VI/2006, LEP-UFRRJ 1455, 3 specimens.

Apareiodon piracicabae (Total *N*: 101 specimens; see Table 1): Brazil, São Paulo, Entupido Stream, Queluz (22°33′45″ S, 044°48′45″ W), A. Iacone, 02/II/2009,

Table 1. Information on geographic occurrences and type of gear (EF = electrofishing; GN = gill net) used to collect *Apareiodon itapicuruensis* (Eigenmann & Henn, 1916) and *Apareiodon piracicabae* (Eigenmann, 1907) in the Paraíba do Sul river basin and their type localities. MC = main channel. *N* = number of examined specimens.

Species	Sites	Latitude (S)	Longitude (W)	*N*	Gear	Type locality in Brazil
A. itapicuruensis	Paraíba do Sul River (MC)	22°07′16.1″	043°12′33.9″	3	GN	Paiaia River, tributary of the Itapicuru River, Bahia
A. piracicabae	Paraíba do Sul River (MC)	22°32′25″ 22°33′48″ 22°32′13 ″	044°10′13″ 044°51′38″ 044°46′26″	5	GN	Piracicaba River, Piracicaba, São Paulo
A. piracicabae	Piraí River	22°45′02.9″	044°07′38″	15	GN	Piracicaba River, Piracicaba, São Paulo
A. piracicabae	Preto River	22°05′4.27″	043°30′18.21″	10	GN	Piracicaba River, Piracicaba, São Paulo
A. piracicabae	Entupido Stream	22°33′45″	044°48′45″	56	EF	Piracicaba River, Piracicaba, São Paulo
A. piracicabae	Morro Grande Stream	22°33′47.2″	044°50′31.0″	1	EF	Piracicaba River, Piracicaba, São Paulo
A. piracicabae	São Roque Stream	22°31′13.43″	044°40′33.21″	14	EF	Piracicaba River, Piracicaba, São Paulo

Figure 2. Specimen of *Apareiodon itapicuruensis* (LEP-UFRRJ 1455).

Figure 3. Specimen of *Apareiodon piracicabae* (LEP-UFRRJ 1565).

LEP-UFRRJ 0984, 11 specimens. Brazil, São Paulo, Paraíba do Sul River after PCH Lavrinhas, Lavrinhas (22°33′48″ S 44°51′38″ W), A. Iacone,03/VII/2013, LEP-UFRRJ 0985, 1 specimen. Brazil, São Paulo, Paraíba do Sul River, Queluz (22°32′13″ S, 044°46′26″ W), B. F. Terra et al.,27/I/2013, LEP-UFRRJ 1081,1 specimen. Brazil, São Paulo, São Roque Stream, Paraíba do Sul river basin (22°31′13″ S, 044°40′26″ W), B. F. Terra et al., 16/I/2013, LEP-UFRRJ 1082, 1 specimen. Brazil, Queluz, São Roque Stream, Paraíba do Sul river basin, Queluz (22°31′13″ S, 044°40′26″ W), B. F. Terra et al., 19/III/2013, LEP-UFRRJ 1211, 7 specimens. Brazil, Queluz, São Roque Stream, Paraíba do Sul river basin, Queluz (22°31′13″ S, 044°40′26″ W), B. F. Terra et al., 01/IV/2013, LEP-UFRRJ 1212, 2 specimens. Brazil, Queluz, São Roque Stream, Paraíba do Sul river basin, Queluz (22°31′13″ S, 044°40′26″ W), B. F. Terra et al., 01/IV/2013, LEP-UFRRJ 1213, 3 specimens. Brazil, Queluz, São Roque Stream, Paraíba do Sul river basin, Queluz (22°31′13″ S, 044°40′26″ W), B. C. T. Pinto, 17/X/2008, LEP-UFRRJ 1453, 1 specimen. Brazil, São Paulo, Entupido Stream, Queluz (22°33′45″ S, 044°48′45″ W), B. C. T. Pinto, 20/XI/2009, LEP-UFRRJ 1454,11 specimens. Brazil, São Paulo, Entupido Stream, Queluz (22°33′45″ S, 044°48′45″ W), F. L. K. Salgado et al., 22/VIII/2009, LEP-UFRRJ 1467,27 specimens. Brazil, Rio de Janeiro, Paraíba do Sul River, Barra Mansa (22°32′25″ S, 044°10′13″ W), M. Bastos, 14/IX/2011, LEP-UFRRJ 1546,2 specimens. Brazil, São Paulo, Morro Grande Stream, Lavrinhas (22°33′47.2″ S, 044°50′31.0″ W), B. F. Terra et al., 19/I/2013, LEP-UFRRJ 1548,1 specimen. Brazil, São Paulo, Paraíba do Sul River, Queluz (22°32′13″ S, 044°46′26″W), B. F. Terra et al., 28/X/2012, LEP-UFRRJ 1611,1 specimen. Brazil, São Paulo, Entupido Stream, Queluz (22°33′45″ S, 044°48′45″ W), B. C. T. Pinto, 10/XII/2008, LEP-UFRRJ 1631,3 specimens. Brazil, São Paulo, Entupido Stream, Queluz (22°33′45″ S, 044°48′45″ W), B. Terra, 20/X/2009, LEP-UFRRJ 1632,1 specimen. São Paulo, Entupido Stream, Queluz (22°33′45″ S, 044°48′45″ W), B. Terra, 10/XII/2008, LEP-UFRRJ 1635, 3 specimens. Brazil, Rio de Janeiro, Piraí River, Piraí (22°45′02.9″ S, 044°07′38″ W), LEP-UFRRJ 2123,15 specimens. Brazil, Rio de Janeiro, Preto River, Rio das Flores (22°05′4.27″ S, 043°30′18.21″ W), LEP-UFRRJ 2124, 10 specimens.

Apareiodon itapicuruensis differed from other species of *Apareiodon* by the lower numbers of scales in the lateral line (35–36 vs 38–44), predorsal series (10–11 vs 12–14), numbers of scales in the series between the isthmus and the anus (23–24 vs 28–30), numbers of cuspids of pre-maxillary teeth (9–10 vs 12–16), and higher number of cuspids of maxillary teeth (7 vs 5–6). This species has body height between 25.0 and 26.1% SL (vs 20.3–24.4%

SL) (Table 2). *Apareiodon piracicabae* can be differed of other species by higher numbers of scales in the series between the isthmus and the anus (28–30 vs 23–24) and number of longitudinal strips (2 vs 1) (Table 3).

Both species have mouth distinctly inferior, a dark streak along the lateral line, and a second one above the first or second row of scales above it. *Apareiodon itapicuruensis* has the head 4.5 times in the SL, depth 4–4.5 in the SL, dorsal 11–12 rays, anal 8 rays, eye diameter 1.25 in snout, 3.5 in the head, snout equal to interorbital, which is 3 times in the head, lateral line with 35–36 scales, and interorbital 3 times in the head length. Dorsal profile gently curved and ventral profile flattened, horizontal, or curved. *Apareiodon piracicabae* has the head 5 times in the SL, depth 4.33–4.75 in the SL, dorsal 10–12 rays, anal 8 rays, eye diameter 3.6–4 times in the head, lateral line with 41–43 scales, and interorbital less or equal to ⅓ of the head length. Dorsal and ventral profiles about equally arched.

Discussion

The occurrence of 2 species of the genus *Apareiodon* in the Paraíba do Sul river basin was recorded for the first time in this study, and their morphometrics, meristics, and patterns of color match with the diagnostic characters of the formal description for *A. itapicuruensis* and *A. piracicabae*.

*Apareiodon itapicuruensis*is only found in coastal basins of Bahia (Eigenmann 1916), approximately 1000 km far from the Paraíba do Sul river basin. It seems highly unlikely that the species occurs naturally in Rio de Janeiro and São Paulo states, with no recorded in Espírito Santo State that is located between those states. However, is important to bear in mind that still there are several streams and rivers still un-sampled or sub-sampled or even degraded habitats with punctual extinctions. *Apareiodon piracicabae* occurs in the São Francisco and in the Upper Paraná River basins, including the Jaguari and Atibaia river basins. These 2 rivers belong to the Cantareira System (Paraná River basin); a recent artificial connection, planned by the São Paulo government, with the Jaguari River (Paraiba do Sul river basin) will allow interchanges of fish fauna between the 2 basins. One of the hypotheses for the colonization of this species in the Paraíba do Sul river basin may be the leakage of fish culture farms, since there are records of species of the genus *Apareiodon* being used as forage for larger fish in the past (Bialetzki et al. 1998). On the other hand, it is known that the Upper Paraná, São Francisco, and Paraíba do Sul rivers share several fish species (Menezes et al. 2007), and this raises the possibility that *A. piracicabae* has naturally colonized the Paraiba do Sul river in the past, but further studies on this issue should be done to test this hypothesis. Similar to the characin *Pseudocorynopoma heterandria* Eigenmann, 1914, that is supposed to be introduced into the Paraíba do Sul river basin through fish culture farm leakage (Salgado et al. 2015), we should not disregard that both *A. piracicabae and P. heterandria* could have naturally colonized the Paraiba do Sul River, since both species have their original description form the Upper Paraná River basin. Another possible reason that reinforces the hypothesis of deliberate introduction in the basis is that these species have not been recorded before in the Paraíba do Sul River in spite of several previous studies in the basin. Further studies that incorporate examination of specimens of *Apareiodon* spp. in other areas and visit to museums should be done to make a more holistic determination of the geographical distribution of this genus.

Species invasions can cause the reduction in richness and diversity of native communities, or even species extinctions (Clavero and García-Berthou 2005, Pelicice and Agostinho 2009, Ortega et al. 2015). The invader *Apareiodon* spp., could, for example, compete with and harm the native genera of *Astyanax* [such as *Astyanax hastatus* Myers, 1928, *Astyanax parahybae* Eigenmann, 1908, *Astyanax giton* Eiganmann, 1908 and *Astyanax* aff. *bimaculatus* (Linnaeus, 1728)], since they have similar size and morphological characters with probably similar functions in the environment. The discovery of possible invasive species can allow a better adaptation of conservation measures to be adopted targeting both invasive species (e.g. population control and better containment measures) and native species (e.g. assisted reproduction and restocking).

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Authors' Contributions

BFT and GSC collected the data; FLKS identified the specimens; FLKS, BFT, GSC, and FGA wrote the text.

References

Araújo FG, Pinto BCT, Teixeira TP (2009) Longitudinal patterns of fish assemblages in a large tropical river in southeastern Brazil: evaluating environmental influences and some concepts in river ecology. Hydrobiologia 618: 89–107. https://doi.org/10.1007/s10750-008-9551-5

Morphological characterization and temporal distribution of larvae and juveniles of *Apareiodon affinis* ((Steindachner, 1879) (Osteichthyes, Parodontidae) in upper Paraná River, Paraná (Caracterização morfológica e distribuição temporal de larvas e juvenis de *Apareiodon affinis* ((Steindachner, 1879) (Osteichthyes, Parodontidae) no alto rio Paraná, Paraná) Revista Brasileira de Zoologia 15: 1037–1047. https://doi.org/10.1590/S0101-81751998000400021

Bizerril CRFS (1999) A ictiofauna da bacia do Rio Paraíba do Sul. Biodiversidade e padrõesbiogeográficos. Brazilian Archives of Biology and Technology 42: 233–250. https://doi.org/10.1590/S1516-89131999000200014

Clavero M, García-Berthou E (2005) Invasive species are a leading cause of animal extinctions. Trends in Ecology and Evolution 20 (3): 110. https://doi.org/10.1016/j.tree.2005.01.003

Eigenmann CH (1916) On *Apareiodon*, a new genus of characid fishes. Annals of the Carnegie Museum 10 (1–2): 71–76.

Eschmeyer WN, Fong R (2017) (Eds) Catalog of Fishes, Electronic Version. http://research.calacademy.org/research/ichthyology/catalog/fishcatmain.asp. Accessed on: 2017-10-05.

Menezes NA, Weitzman S, Oyakawa OT, Lima F, Castro R, Weitzman M (2007) Fresh-water Fish of Mata Atlântica: Preliminary List of Species and Comments on Conservation of Neotropical Freshwater Fishes. Museu de Zoologia/USP, São Paulo, 407 pp.

Ortega JCG, Júlio Jr. HF, Gomes LC, Agostinho AA (2015) Fish farming as the main driver of fish introductions in Neotropical reservoirs. Hydrobiologia 746: 147–158. https://doi.org/10.1007/s10750-014-2025-z

Pavanelli CS (2003) Parodontidae (Parodontids). In: Reis RE, Kullander SO, Ferraris Jr CJ (Eds) Checklist of the Freshwater Fishes of South and Central America. EDIPUCRS, Porto Alegre, 46–50.

Pavanelli CS (2006) News species of *Apareiodon* (Teleostei: Characiformes: Parodontidae) from the Rio Piquiri, Upper Rio Paraná Basin, Brazil. Copeia 2006 (1): 89–95.

Pavanelli CS, Britski HA (2003) *Apareiodon* Eigenmann, 1916 (Teleostei, Characiformes) from the Tocantins-Araguaia basin, with description of three new species. Copeia 2003 (2): 337–348. https://doi.org/10.1643/0045-8511(2003)003

Pelicice FM, Agostinho AA (2009) Fish fauna destruction after the introduction of a non-native predator (*Cichla kelberi*) in a Neotropical reservoir. Biological Invasions 11: 1789–1801. https://doi.org/10.1007/s10530-008-9358-3

Salgado FLK, Terra BF, Camilo GS, Silva EO, Araújo FG (2015) Ocurrence of *Pseudocorynopoma heterandria* Eigenmann, 1914 (Characidae) in Paraíba do Sul river basin (southeastern Brazil). Journal of Applied Ichthyology 31: 390–392. https://doi.org/10.1111/jai.12657

Sazima I (1980). Behavior of two Brazilian species of parodontid fishes, *Apareiodon piracicabae* and *A. ibitiensis*. Copeia 1980 (1):166–169. https://doi.org/10.2307/1444157

Teixeira TP, Pinto BCT, Terra BF, Estiliano EO, Gracia D, Araújo FG (2005) Diversity of fish assemblages in the four geographic units of the Paraíba do Sul River. Iheringia Series Zoology 95: 347–357. https://doi.org/10.1590/S0073-47212005000400002